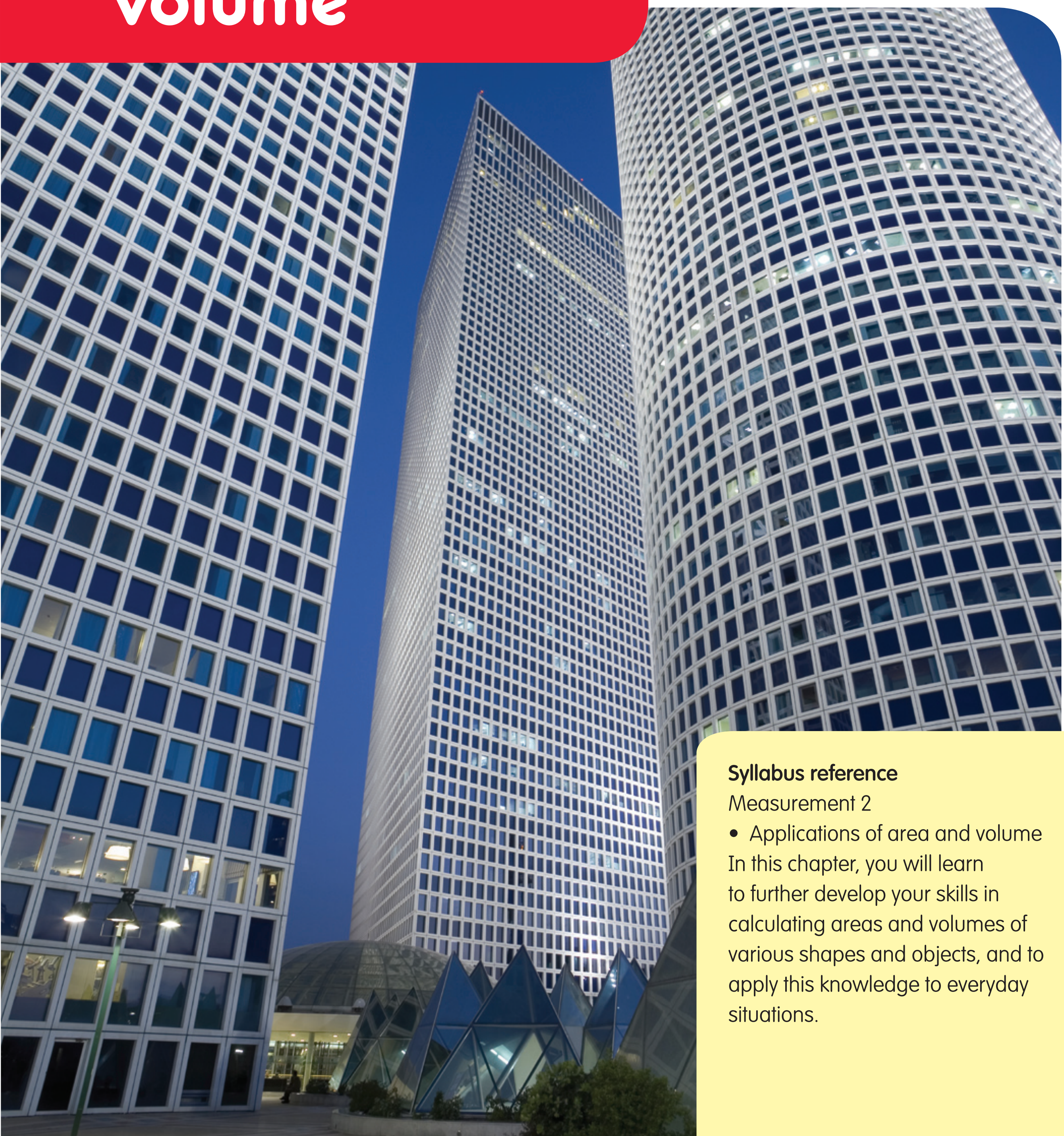
3 Applications of area and volume

3A Review of area
3B Calculating irregular areas from a field diagram
3C Solid shapes
3D Surface area
3E Volume of a prism
3F Volume of other solids



Syllabus reference

Measurement 2

- Applications of area and volume

In this chapter, you will learn to further develop your skills in calculating areas and volumes of various shapes and objects, and to apply this knowledge to everyday situations.

ARE YOU READY?

Try the questions below. If you have difficulty with any of them, extra help can be obtained by completing the matching SkillSHEET. Either click on the SkillSHEET icon next to the question on the *Maths Quest Preliminary Course* eBookPLUS or ask your teacher for a copy.

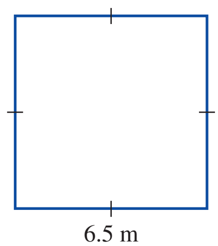
eBook*plus*

Digital doc
SkillSHEET 3.1
doc-1470
Area of squares, rectangles, triangles and circles

Area of squares, rectangles, triangles and circles

1 Find the area of each of the following.

a



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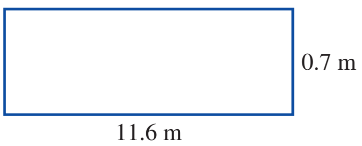

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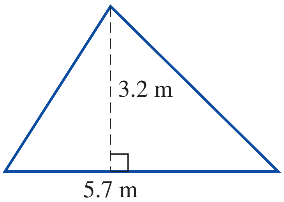

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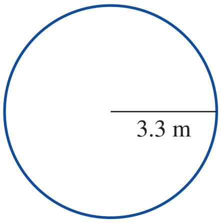

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SkillSHEET 3.2
doc-1471
Converting units of area

Converting units of area

2 Complete each of the following.

a $2\ \text{cm}^2 = \_\_\_\ \text{mm}^2$ **b** $300\,000\ \text{cm}^2 = \_\_\_\ \text{m}^2$ **c** $50\,000\ \text{m}^2 = \_\_\_\ \text{ha}$

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SkillSHEET 3.3
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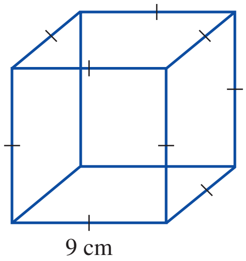
Surface area of cubes and rectangular prisms

Surface area of cubes and rectangular prisms

3 Find the surface area of:

a



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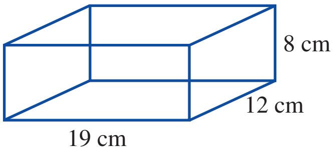

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SkillSHEET 3.5
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Converting units of volume

Converting units of volume

4 Complete each of the following.

a $2\ \text{cm}^3 = \_\_\_\ \text{mm}^3$ **b** $3\,000\,000\ \text{cm}^3 = \_\_\_\ \text{m}^3$ **c** $5000\ \text{mm}^3 = \_\_\_\ \text{cm}^3$

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Digital doc
SkillSHEET 3.6
doc-1480
Volume of cubes and rectangular prisms

Volume of cubes and rectangular prisms

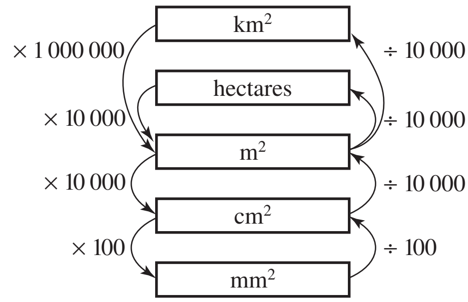
5 Calculate the volume of the figures drawn in question **3**.

3A Review of area

Area is a measure of the amount of space within a closed shape. Area is expressed in square units. The exception to this rule is the hectare (ha).

$$100\ \text{mm}^2 = 1\ \text{cm}^2$$
$$10\ 000\ \text{cm}^2 = 1\ \text{m}^2$$
$$10\ 000\ \text{m}^2 = 1\ \text{ha}$$
$$1\ 000\ 000\ \text{m}^2 = 1\ \text{km}^2 = 100\ \text{ha}$$

To convert between units we can use the flow chart at right.



A square unit is a space equal to that of a square with that particular side length. For example, a square centimetre is the amount of space contained within a square with each side 1 cm.

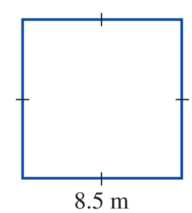
Most common shapes have a formula that we can use to find the area of that shape.

Square

The formula for the area of a square is $A = s^2$ where s represents the side length of the square.

WORKED EXAMPLE 1

Find the area of the square at right.



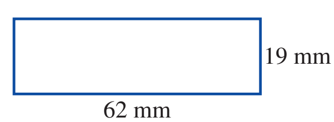
THINK	WRITE
1 Write the formula.	$A = s^2$
2 Substitute the side length.	$= 8.5^2$
3 Calculate the area.	$= 72.25\ \text{m}^2$

Rectangles

The formula for the area of a rectangle is $A = l \times b$ where l = length and b = breadth.

WORKED EXAMPLE 2

Find the area of the rectangle at right.



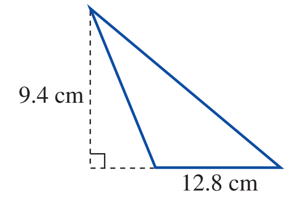
THINK	WRITE
1 Write the formula.	$A = l \times b$
2 Substitute the length and the breadth.	$= 62 \times 19$
3 Calculate the area.	$= 1178\ \text{mm}^2$

Triangles

The formula for the area of a triangle is $A = \frac{1}{2} \times b \times h$ where b is the base of the triangle and h is the perpendicular height.

WORKED EXAMPLE 3

Find the area of the triangle at right.



THINK	WRITE
1 Write the formula.	$A = \frac{1}{2} \times b \times h$
2 Substitute the base and the height.	$= \frac{1}{2} \times 12.8 \times 9.4$
3 Calculate the area.	$= 60.16\ \text{cm}^2$

Other quadrilaterals

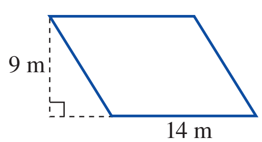
Formulas are also used to find the area of parallelograms, rhombuses and trapeziums.

Area of a parallelogram	$A = b \times h$	(b = base, h = height)
Area of a rhombus	$A = \frac{1}{2} \times D \times d$	(D, d = diagonals)
Area of a trapezium	$A = \frac{1}{2} \times (a + b) \times h$	(a, b = parallel sides, h = height)

WORKED EXAMPLE 4

Find the area of each of the following shapes.

a



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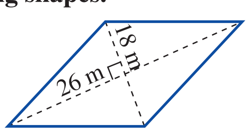

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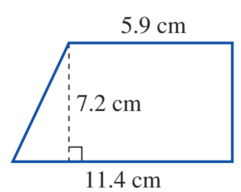

THINK	WRITE
a 1 Write the formula.	**a** $A = b \times h$
2 Substitute the base and height.	$= 14 \times 9$
3 Calculate the area.	$= 126\ \text{m}^2$
b 1 Write the formula.	**b** $A = \frac{1}{2} \times D \times d$
2 Substitute the diagonal lengths.	$= \frac{1}{2} \times 18 \times 26$
3 Calculate the area.	$= 234\ \text{m}^2$
c 1 Write the formula.	**c** $A = \frac{1}{2} \times (a + b) \times h$
2 Substitute the sides and height.	$= \frac{1}{2} \times (5.9 + 11.4) \times 7.2$
3 Calculate the area.	$= 62.28\ \text{cm}^2$

Circles

The area of a circle can only be found exactly in terms of π. The area of a circle is found using the formula $A = \pi r^2$. To get a numerical answer an approximation needs to be made.

WORKED EXAMPLE 5

Find the area of a circle with a radius of 5.6 cm, give your answer correct to two decimal places.

THINK	WRITE
1 Write the formula.	$A = \pi r^2$
2 Substitute the radius.	$= \pi \times 5.6^2$
3 Calculate and round off to two decimal places.	$= 98.52\text{ cm}^2$

You should have studied all of these formulas in Years 7–10. You will be expected to know these formulas in your exams as they will not be given to you on your formula sheet.

REMEMBER

You will need to remember each of the following area formulas.

1. Square $A = s^2$
2. Rectangle $A = l \times b$
3. Triangle $A = \frac{1}{2} \times b \times h$
4. Parallelogram $A = b \times h$
5. Rhombus $A = \frac{1}{2} \times D \times d$
6. Trapezium $A = \frac{1}{2} \times (a + b) \times h$
7. Circle $A = \pi r^2$

EXERCISE 3A Review of area

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SkillSHEET 3.1
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Area of squares, rectangles, triangles and circles

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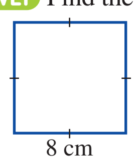
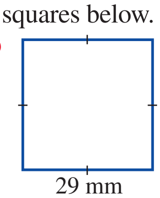
Digital doc
SkillSHEET 3.2
doc-1471
Converting units of area

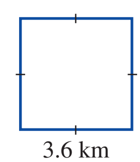
eBookplus

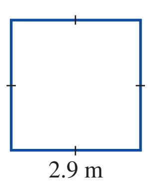
Digital doc
EXCEL Spreadsheet
doc-1472
Area converter (DIY)

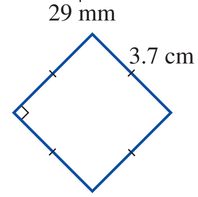
1 WE1 Find the area of each of the squares below.

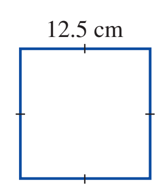
a 

b 

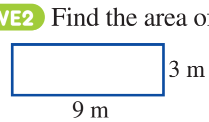
c 

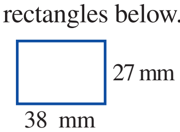
d 

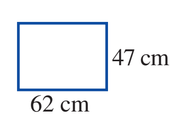
e 

f 

2 WE2 Find the area of each of the rectangles below.

a 

b 

c 

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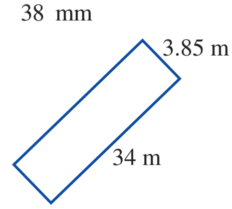
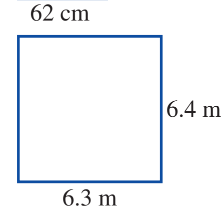
e 

f 

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GC program — TI
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Mensuration

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EXCEL Spreadsheet
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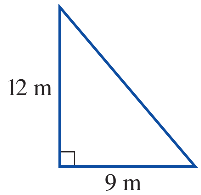
Perimeter and area

3 WE3 Find the area of each of the triangles below.

a


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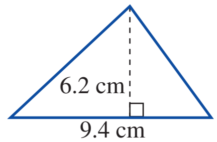

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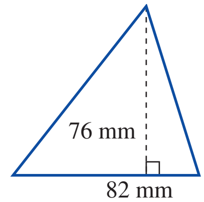

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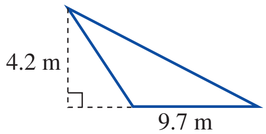

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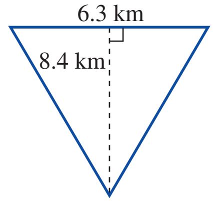

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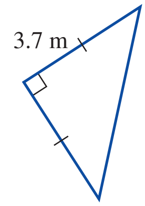
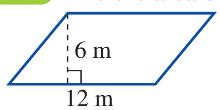


4 WE4a Find the area of each of the parallelograms below.

a


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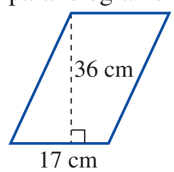

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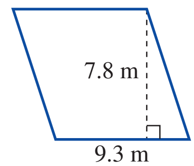

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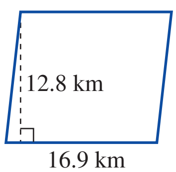

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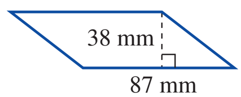

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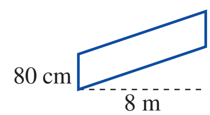
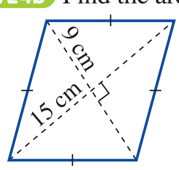


5 WE4b Find the area of each of the rhombuses below.

a


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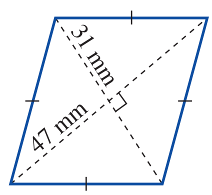

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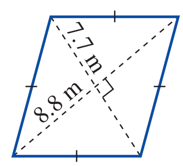

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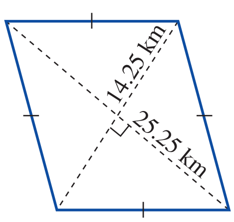

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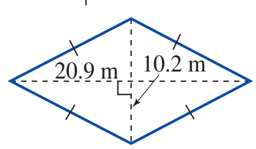

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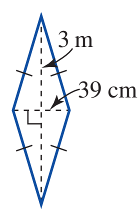
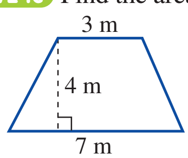


6 WE4c Find the area of each of the trapeziums below.

a


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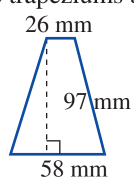

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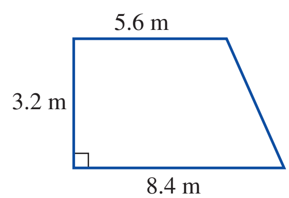

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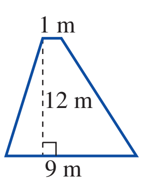

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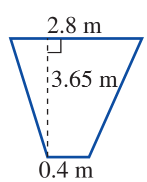

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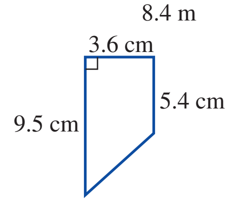
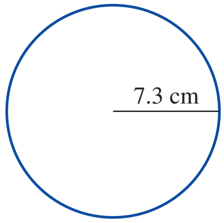


7 **WE5** Find the area of each of the following circles correct to two decimal places.

a



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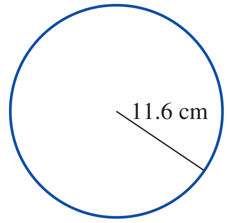

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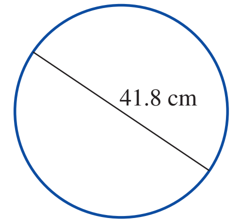
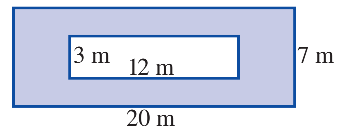


8 Look at the figure at right.

a Find the area of the outer rectangle.

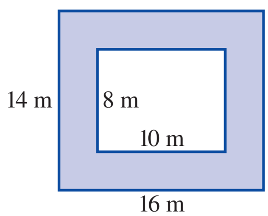
b Find the area of the inner rectangle.

c Find the shaded area by subtracting the area of the inner rectangle from the area of the outer rectangle.



9 Find the shaded area in each of the following.

a



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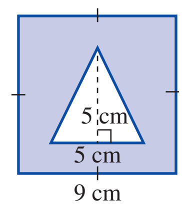
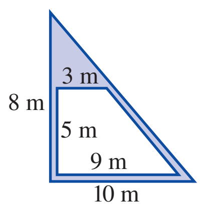
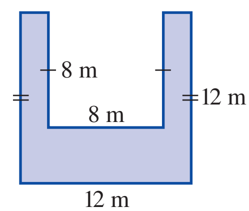


c



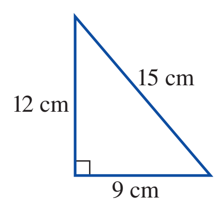
d



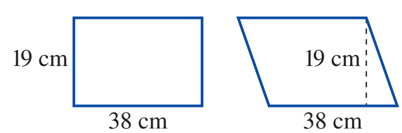
10 **MC** The area of the triangle at right is:

A 36 cm^2 **B** 54 cm^2

C 108 cm^2 **D** 1620 cm^2



11 **MC** Which of the two statements is correct for the two shapes at right?



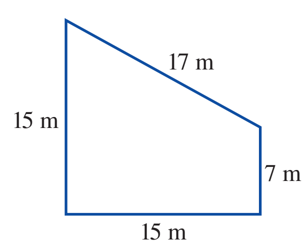
Statement 1. The rectangle and parallelogram have equal areas.
Statement 2. The rectangle and parallelogram have equal perimeters.

A Statement 1 **B** Statement 2 **C** Both statements **D** Neither statement

12 **MC** The area of the figure at right is:

A 54 m^2 **B** 165 m^2

C 225 m^2 **D** 255 m^2



13 Len is having his lounge room carpeted. Carpet costs \$27.80/m^2. The lounge is rectangular with a length of 7.2 m and a width of 4.8 m.

a Calculate the area of the lounge room.

b Calculate the cost of carpeting the room.

Further development

14 A rectangular garden in a park is 15 m long and 12 m wide. A concrete path 1.5 m wide is to be laid around the garden.

a Draw a diagram of the garden and the path.

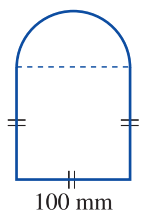
b Find the area of the garden.

c What are the dimensions of the rectangle formed by the path?

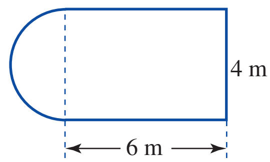
d Find the area of concrete needed for the path.

15 Find the area of each of the following composite figures.

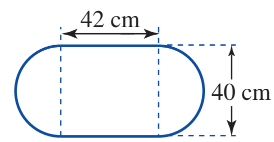
a



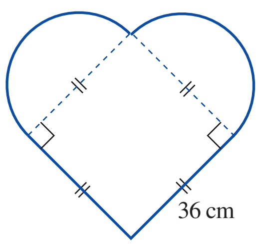
b



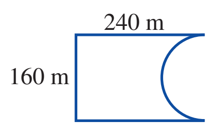
c



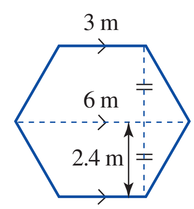
d



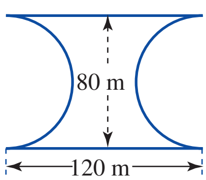
e



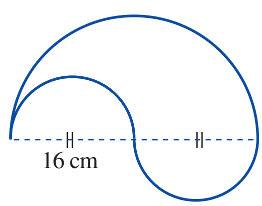
f



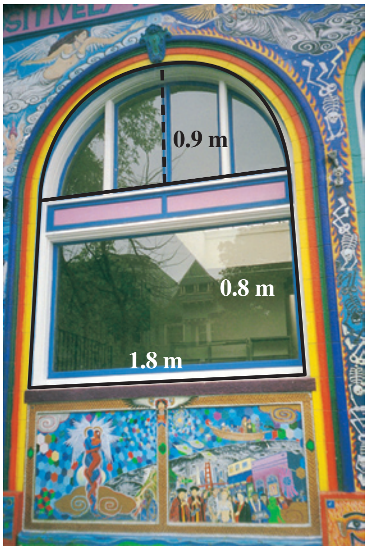
g



h



16 Find the area of glass in the window shown. Give your answer correct to two decimal places.



17 Complete each of the following.

a 23 400 m^2 = ______ km^2

b 0.06 cm^2 = _____ mm^2

c 5 500 000 cm^2 = _____ m^2

d 0.008 m^2 = _____ cm^2

e 0.73 km^2 = _____ m^2

f 200 mm^2 = _____ cm^2

g 49 000 m^2 = ___ ha

h 5 ha = _____ km^2

18 A National Park has an area of 500 000 ha.

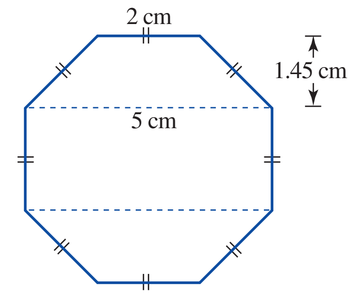
a Calculate the area in square kilometres.

b A mining company wants to claim 4% of the National Park for their industry. Calculate the number of square metres they are claiming.

19 Find the area of:

a the hexagon at right

b the octagon at right.



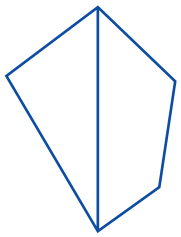
INVESTIGATE: Maximising an area of land

Farmer Brown needs to build a paddock for her sheep to graze. She has 1000 m of fencing with which to build this paddock.

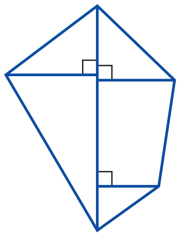
1. If Farmer Brown builds the paddock 100 m long and 400 m wide, the area will be 40 000 m^2. If she builds it 200 m long and 300 m wide, the area will be 60 000 m^2. With what dimensions should Farmer Brown build the paddock so it has the maximum possible area?
2. If one side of the paddock is a river, only three sides need to be fenced. If Farmer Brown still uses 1000 m of fencing, what dimensions should she now make the paddock to maximise the area?

It is possible for you to set up a spreadsheet that will calculate the area of a rectangle and substitute different values for the length and width of the paddock. Use the spreadsheet to find the maximum area of the paddock.

3B Calculating irregular areas from a field diagram



Surveyors are often required to draw scale diagrams and to calculate the area of irregularly shaped blocks of land. This is done using a **traverse survey**. In this survey, a diagonal (traverse) is constructed between two corners of the block. The diagonal is then measured.



From this diagonal each other corner is sighted at right angles to the diagonal. Each of these lines, called an **offset**, is measured.

These offsets then divide the block into triangles and quadrilaterals, hence we can calculate the area.

The results of a traverse survey are displayed in a field diagram.

The measurements through the centre of the field diagram are the points at which the offsets are taken. 100 metres is the length of the diagonal. At the sides are the measurements from the diagonal to the corners.

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Interactivity
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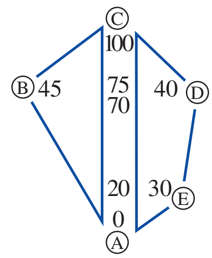
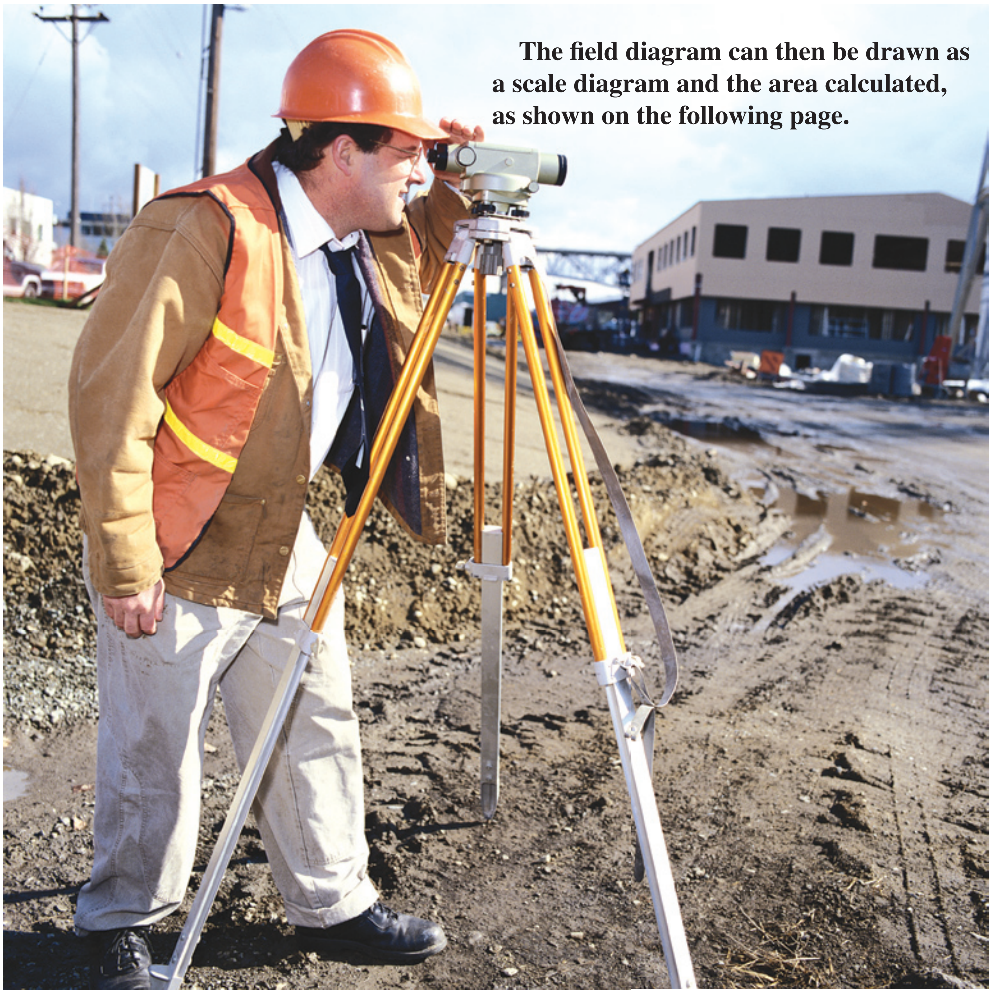
Field diagram





The field diagram can then be drawn as a scale diagram and the area calculated, as shown on the following page.

WORKED EXAMPLE 6

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Tutorial
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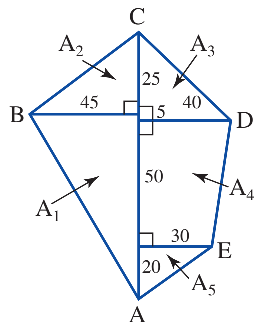
Worked example 6

Use the field diagram on the previous page to:
a **draw a scale diagram of the field (use 1 mm = 1 m)**
b **calculate the area of the field.**

THINK	WRITE
a 1 Draw a 100 mm line. 2 Draw in all offsets at the appropriate points on the traverse line. 3 Join all corners of the field. 4 Write all measurements on your diagram.	**a** 
b 1 Calculate the area of the four triangles and the trapezium.	**b** $A_1 = \frac{1}{2} \times b \times h = \frac{1}{2} \times 75 \times 45 = 1687.5\text{ m}^2$ $A_2 = \frac{1}{2} \times b \times h = \frac{1}{2} \times 25 \times 45 = 562.5\text{ m}^2$ $A_3 = \frac{1}{2} \times b \times h = \frac{1}{2} \times 30 \times 40 = 600\text{ m}^2$ $A_4 = \frac{1}{2} \times (a + b) \times h = \frac{1}{2} \times (40 + 30) \times 50 = 1750\text{ m}^2$ $A_5 = \frac{1}{2} \times b \times h = \frac{1}{2} \times 20 \times 30 = 300\text{ m}^2$
2 Add the areas together.	$\text{Area} = 1687.5 + 562.5 + 600 + 1750 + 300 = 4900\text{ m}^2$

When you draw a scale diagram of the block of land, you can use measurement to find the perimeter.

INVESTIGATE: Land survey

1. Find an area of land in or near your school and conduct a traverse survey of it.
2. Draw a scale diagram of the area of land.
3. Calculate the area of the land.
4. Find the perimeter of the block.

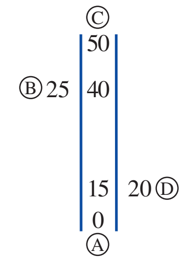
REMEMBER

1. A traverse survey is used to calculate the area of irregularly shaped blocks of land.
2. A field diagram can be used to make a scale drawing of the land.
3. The land can be broken up into triangles and quadrilaterals. The area can then be calculated.

EXERCISE

3B Calculating irregular areas from a field diagram

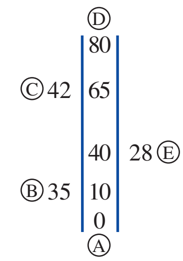
1 WE6 At right is a surveyor's field diagram of a block of land.



a Draw a scale diagram of the block of land, using the scale 1 mm = 1 m.

b Calculate the area of the block of land.

2 For the field diagram shown at right:



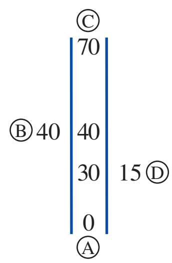
a draw a scale diagram of the block of land using the scale 1 mm = 1 m

b calculate the area of the block of land

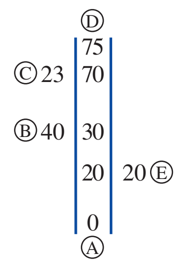
c use measurement to find the perimeter.

3 Use the field diagrams below to calculate the area of each block of land.

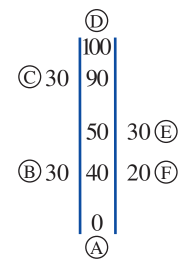
a



b

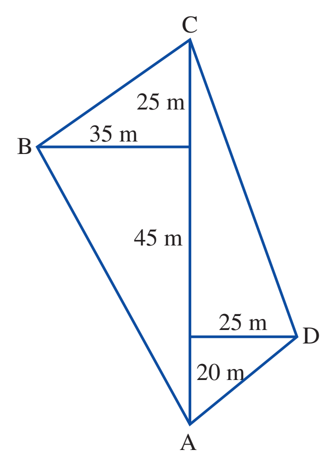


c

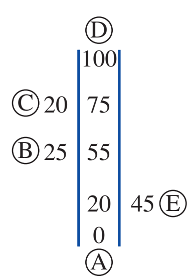


Further development

4 For the diagram at right sketch the surveyor's field diagram.



5 Consider the field diagram drawn below.



Is the shortest path from A to D via E or via B and C?

6 For the field diagram in question **5** determine if the area ABCD or AED is larger.

7 A traverse line is 100 metres long from point A to point B. Alan is to set an offset at C 25 metres at right angles to the traverse line. Where should Alan set the offset to maximise the area of ABC?

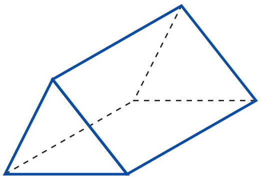
3C Solid shapes

So far in this chapter we have dealt with 2-dimensional (plane) shapes. We also need to be able to recognise, classify and draw 3-dimensional (solid) shapes. Most of the solid shapes that we will be dealing with in this chapter can be classified as either **prisms** or **pyramids**.

A prism is a solid shape with a constant cross-section, usually a polygon. This means that if the solid is sliced parallel to the base of the prism, the shape seen will be identical to the base. A prism is named according to the shape of its base.

WORKED EXAMPLE 7

Name the prism at right.

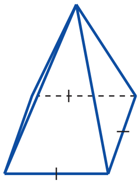


THINK	WRITE
The shape has a common cross-section and the shape of the base is a triangle.	Triangular prism

Pyramids have a plane shape as their base and have triangular sides that meet in an apex. A pyramid is also named according to the shape of its base.

WORKED EXAMPLE 8

Name the pyramid at right.

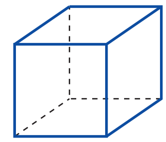
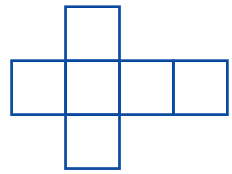


THINK	WRITE
The base shape is a square.	Square pyramid

A solid can also be identified by its net. The net of a solid shape is how the shape would look if it were unfolded and laid flat.

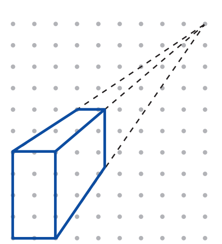
WORKED EXAMPLE 9

Use the diagram of a cube to help you draw its net.

THINK	WRITE
1 The cube has six faces, each of which is a square.	
2 Draw the cube so that the six squares would fold up to form a cube.	

Imagine looking at a pair of railway tracks like those in the photograph below. As you can see, they appear to get closer together. The point on the horizon where they appear to meet is called the vanishing point.

When drawing a solid shape, the sides should slightly converge so that if they were extended they would meet at a similar vanishing point. This can best be done by using isometric paper.

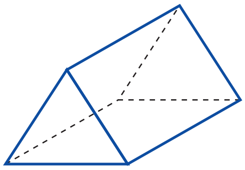


REMEMBER

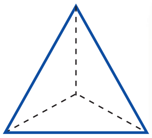
1. A prism is a solid shape where any cross-section parallel to the base is a polygon which is identical to that base shape.
2. A pyramid is a solid shape with a base and triangular sides that meet in an apex.
3. The net of a solid is how that shape would look if it were unfolded and flattened.
4. Solid shapes when drawn in perspective converge on a vanishing point. This point is best found by drawing the shape on isometric paper.

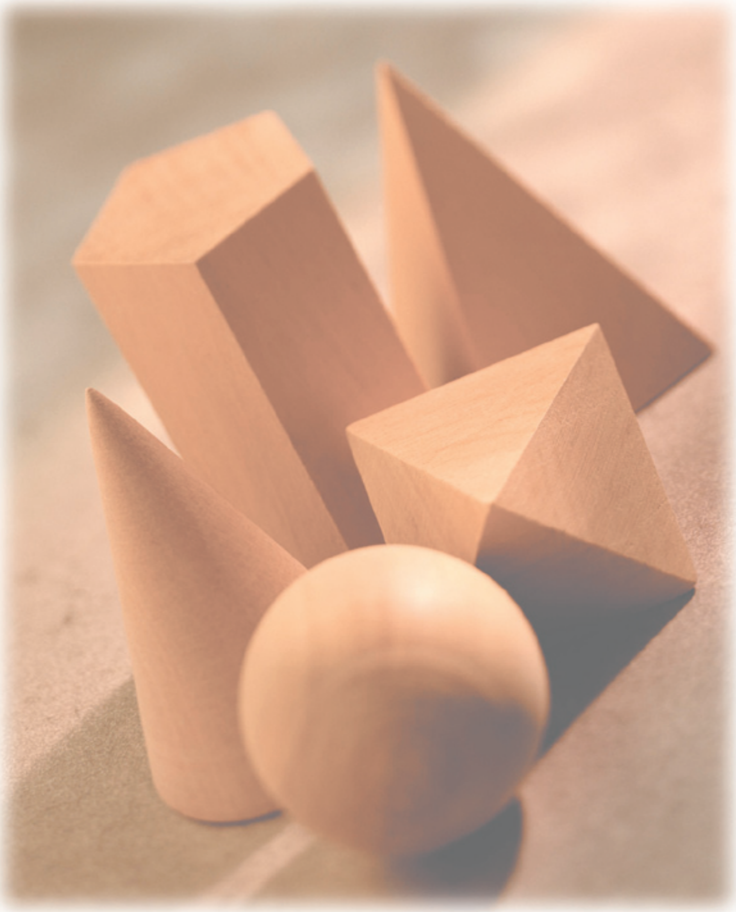
EXERCISE
3C Solid shapes

1 WE7 Name the prism at right.



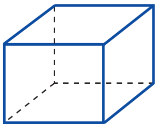
2 WE8 Name the pyramid at right.



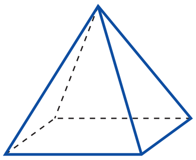


3 Name each of the shapes below.

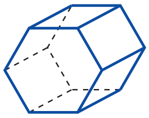
a



b

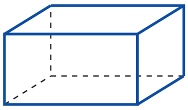


c

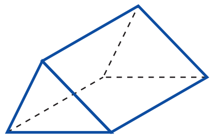


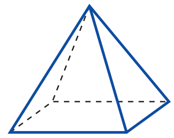
4 Draw your own example of a prism and a pyramid.

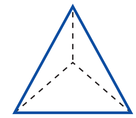
5 WE9 Below is a diagram of a rectangular prism. Use the diagram to help you draw the net of the rectangular prism.

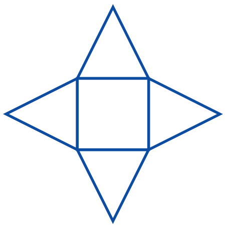


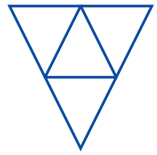
6 Name each solid in the top row then match it with a net in the bottom row.

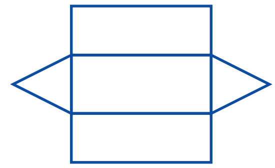
a


b


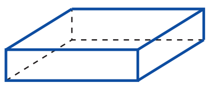
c


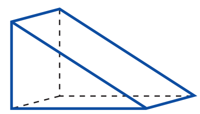
i


ii


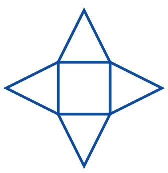
iii


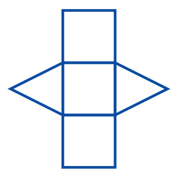
7 Draw the net of each of the following solids.

a


b


8 Identify the solids from the nets below. Draw the solid in your book.

a


b


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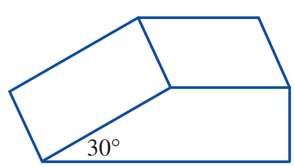
9 Draw an example of each of the following on isometric paper and on your diagram mark the vanishing point.

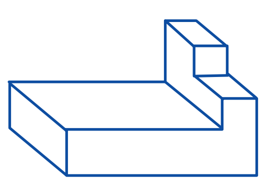
a cube
b rectangular prism
c triangular prism
d square pyramid

Further development

10 Draw a top and front view of the solid drawn below.

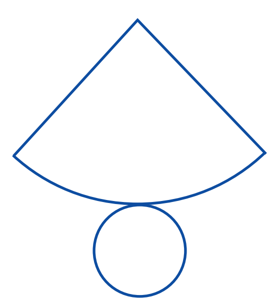


11 Draw a top and front view of the solid drawn below.



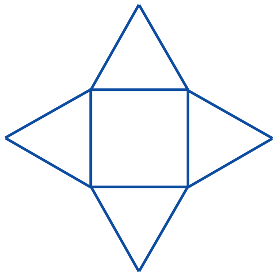
12 Draw the net of a cylinder.

13 Identify the figure for which the net is drawn at right.

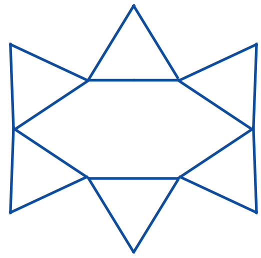


14 From the nets drawn below identify if the solid will be a prism or a pyramid.

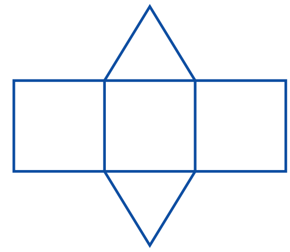
a



b



c

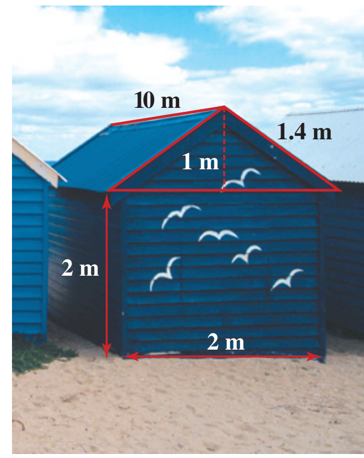


15 Damien is planning to paint his beach shack.

a Draw a net of the beach shack given that it has no solid flooring.

b Name the two solid shapes that make up the shack

c Find the area to be painted.



3D Surface area

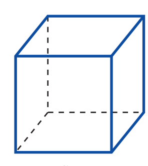
Area usually refers to the space inside a 2-dimensional shape. Surface area refers to the total area occupied by the faces of a 3-dimensional shape. Surface area is measured in square units as are 2-dimensional area problems. In general, the surface area of a solid needs to be calculated by adding the area of each face separately. However, for some solids there is a unique formula.

Cube

A cube has six identical faces, each of which is a square. Consider a cube of side length s.

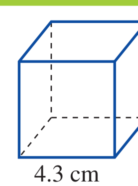
Each face can have its area calculated using the formula $A = s^2$. Therefore, we have the formula for the surface area (SA) of a cube:

$$SA = 6s^2$$



WORKED EXAMPLE 10

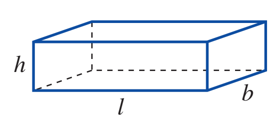
Find the surface area of the cube at right.



THINK	WRITE
1 Write the formula.	$SA = 6s^2$
2 Substitute the side length.	$= 6 \times 4.3^2$
3 Calculate the surface area.	$= 110.94\ \text{cm}^2$

Rectangular prism

Consider a rectangular prism with a length of l, a breadth of b and a height of h.



Each pair of opposite faces are equal. Using the formula for a rectangle:

Front and back $A = l \times h$

Top and bottom $A = l \times b$

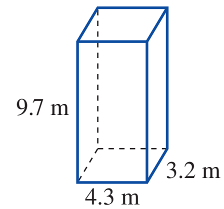
Left and right $A = b \times h$

Adding these gives the formula for the surface area of a rectangular prism:

$$SA = 2(lh + lb + bh)$$

WORKED EXAMPLE 11

Find the surface area of the rectangular prism at right.

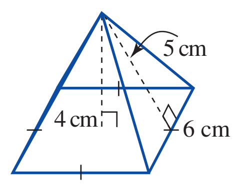


THINK	WRITE
1 Write the formula.	$SA = 2(lh + lb + bh)$
2 Substitute the length, breadth and height.	$= 2(4.3 \times 9.7 + 4.3 \times 3.2 + 3.2 \times 9.7)$
3 Calculate the surface area.	$= 173.02\ \text{m}^2$

For other solid shapes the surface area is found by adding the area of each face separately.

WORKED EXAMPLE 12

Find the surface area of the square pyramid at right.



THINK	WRITE
1 Calculate the area of the square base.	$A = s^2$ $= 6^2$ $= 36\ \text{cm}^2$
2 Calculate the area of a triangular side. (*Note:* Each side is identical and the height of each triangular side is 5 cm.)	$A = \frac{1}{2} \times b \times h$ $= \frac{1}{2} \times 6 \times 5$ $= 15\ \text{cm}^2$
3 Calculate the total surface area. (*Note:* There are 4 identical triangular sides.)	$SA = 36 + 4 \times 15$ $= 96\ \text{cm}^2$

You will be expected to know these formulas for surface area as well. They do not appear on your formula sheet.

REMEMBER

1. The surface area of a solid shape is the total area of each face of the shape.
2. The surface area of a cube or rectangular prism can be found using the formulas:
   Cube: $SA = 6s^2$
   Rectangular prism: $SA = 2(lh \times lb \times bh)$
3. The surface area of any other shape is found by adding the area of each face of the shape.

EXERCISE

3D Surface area

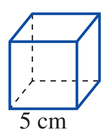
eBook*plus*

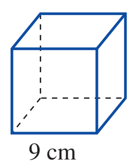
Digital doc
SkillSHEET 3.3
doc-1477
Surface area of cubes and rectangular prisms

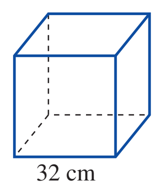
eBook*plus*

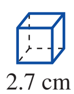
Digital doc
SkillSHEET 3.4
doc-1478
Surface area of triangular prisms

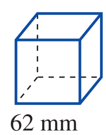
1 WE10 Find the surface area of each of the cubes below.

a


b


c


d


e


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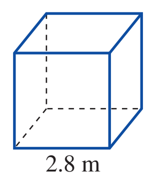
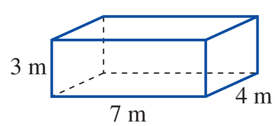
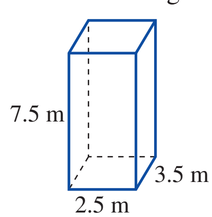
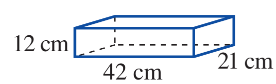
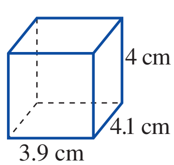


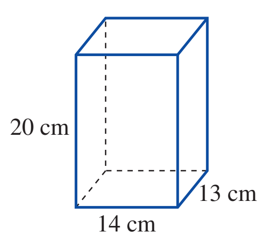
2 WE11 Find the surface area of each of the following rectangular prisms.

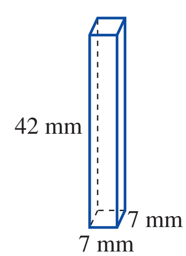
a


b


c


d


e


f


3 Oliver is making a box in the shape of a rectangular prism. The box is to be 2.5 m long, 1.2 m wide and 0.8 m high. Calculate the surface area of the box.

4 Calculate the surface area of an open box in the shape of a cube, with a side length of 75 cm. (*Hint:* Since the box is open there are only five faces.)

5 A room is in the shape of a rectangular prism. The floor is 5 m long and 3.5 m wide. The room has a ceiling 2.5 m high. The floor is to be covered with slate tiles, the walls are to be painted blue and the roof is to be painted white.

a Calculate the area to be tiled.

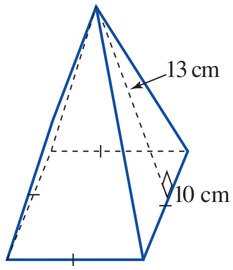
b Each tile is 0.25 m^2. Calculate the number of tiles needed.

c Calculate the area to be painted blue.

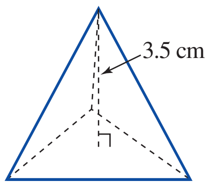
d Calculate the area to be painted white.

e One litre of paint covers an area of 2 m^2. How many litres of paint are needed to paint the room?

6 WE12 Calculate the surface area of the square pyramid at right.



7 A triangular based pyramid has four equal sides as shown at right. Calculate the surface area.



8 MC Two cubes are drawn such that the side length on the second cube is double the side length on the first cube. The surface area of the larger cube will be:

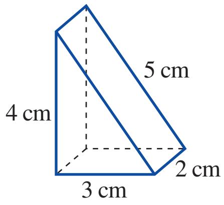
A twice the surface area of the smaller cube

B four times the surface area of the small cube

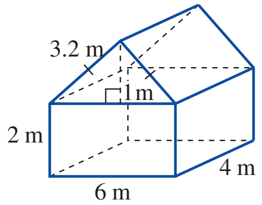
C six times the surface area of the small cube

D eight times the surface area of the small cube

9 Calculate the surface area of the triangular prism below.



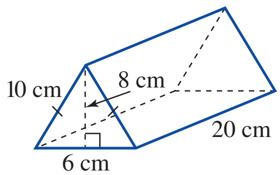
10 Calculate the surface area of the prism below.



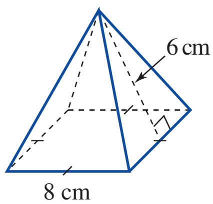
11 Find the surface area of the cube shown at right.

12 Find the surface area of a rectangular prism with a length of 8 cm, a breadth of 5 cm and a height of 6 cm.

13 Find the surface area of the triangular prism below.

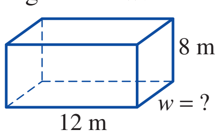


14 Find the surface area of the square pyramid below.



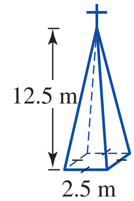
Further development

15 Find the width of the prism in the figure below:



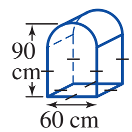
16 A cardboard box is designed to contain a clothes dryer which is 1 m × 1 m × 1 m. The box is to allow an extra 5% on each side to allow the dryer to be placed in and taken out of the box. Find the surface area of the box.

17 The steeple atop a church is in the shape of a square based pyramid, as shown below.



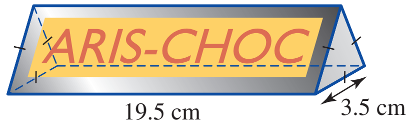
The steeple is to be retiled at a cost of $80 per square metre. If an extra 25% of tiles were allowed for overlap and breakage, find the cost of retiling the steeple.

18 A bread bin has the following design.



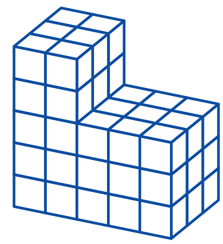
Find the surface area of the bread bin.

19 The figure below shows the packaging for a chocolate bar.



Find the area of cardboard used if the area is increased by 10% for overlap.

3E Volume of a prism



The volume of a solid shape is the amount of space within that shape. Consider the prism at right which has been built with cubes with sides of 1 cm.

We can see by counting squares that the area of the base is 15 cm^2. The height of the prism is 3 cm, and if we count the remaining cubes we find that the volume of the prism is 57 cm^3.

INVESTIGATE: Exploring the volume of a prism

Build the prism that has been drawn above. Count the number of cubes that have been used to build the prism. Build other prisms and count the area of the base, the height and find the volume. Show that the volume can be found by multiplying the area of the front face (base) by the height perpendicular to the front face.

When prisms are drawn, they are usually drawn lying down so that we can see the base.

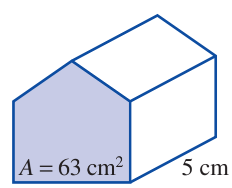
Hence, using the above example we can see that the volume of a prism can be calculated using the formula:

$$V = A \times h$$

where A is the area of the base and h is the height.

WORKED EXAMPLE 13

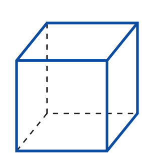
Calculate the volume of the prism at right.



THINK	WRITE
1 Write the formula.	$V = A \times h$
2 Substitute the area of the base and the height.	$= 63 \times 5$
3 Calculate the volume.	$= 315$ cm^3

For some prisms we can develop a more specific formula for volume, without separately calculating the area of the base.

Cube



The front face of the cube is a square of side length s and the height is s.

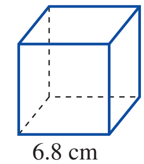
$V = A \times h$

$V = s^2 \times s$ since $A = s^2$ for a square.

$V = s^3$ This becomes the formula used for the volume of a cube.

WORKED EXAMPLE 14

Find the volume of the cube at right.



THINK

1 Write the formula.

2 Substitute the side length.

3 Calculate the volume.

WRITE

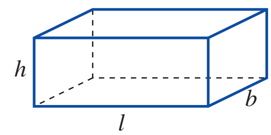
$V = s^3$

$= 6.8^3$

$= 314.432\ \text{cm}^3$

Rectangular prism

Now consider a rectangular prism with a length of l, a breadth of b and a height of h.



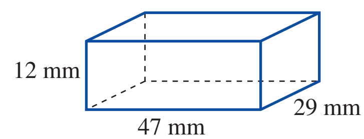
Substituting into the formula:

$V = A \times h$

$V = l \times b \times h \quad$ since $A = l \times b$.

WORKED EXAMPLE 15

Calculate the volume of the rectangular prism at right.



THINK

1 Write the formula.

2 Substitute the length, breadth and height.

3 Calculate the volume.

WRITE

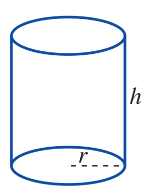
$V = l \times b \times h$

$= 47 \times 29 \times 12$

$= 16\ 356\ \text{mm}^3$

Cylinders

A cylinder can be considered to be a circular prism. Consider the cylinder at right with a radius of r and a height of h.



Substituting into the formula

$V = A \times h$

$V = \pi r^2 h$

since for a circle $A = \pi r^2$.

We also need to be aware of the relationship between volume and capacity. Capacity refers to the amount of liquid that a container holds. Capacity is measured in millilitres, litres and kilolitres.

A volume of $1\ \text{cm}^3 = 1$ mL and $1\ \text{m}^3 = 1000$ L.

WORKED EXAMPLE 16

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Tutorial
int-2481
Worked example 16

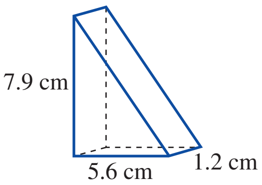
Find the capacity of a cylinder with a radius of 1.3 m and a height of 7.8 m.

THINK	WRITE
1 Write the formula.	$V = \pi r^2 h$
2 Substitute the radius and the height.	$= \pi \times (1.3)^2 \times 7.8$
3 Calculate the volume in m^3.	$\approx 41.412\ \text{m}^3$
4 Calculate the capacity by multiplying the volume by 1000.	Capacity $= 41.412 \times 1000$ $= 41\,412$ L

For any other prism, to calculate the volume we calculate the area of the base first and then use the formula $V = A \times h$.

WORKED EXAMPLE 17

Calculate the volume of the triangular prism at right.



THINK	WRITE
1 Calculate the area of the triangular base.	$A = \frac{1}{2} \times b \times h$ $= \frac{1}{2} \times 5.6 \times 7.9$ $= 22.12\ \text{cm}^2$
2 Write the volume formula.	$V = A \times h$
3 Substitute the area and the height.	$= 22.12 \times 1.2$
4 Calculate the volume.	$= 26.544\ \text{cm}^3$

REMEMBER

1. The volume of a prism is found using the formula $V = A \times h$.
2. Special volume formulas can be used for:
   Cube: $V = s^3$
   Rectangular prism: $V = l \times b \times h$
   Cylinder: $V = \pi r^2 h$.
3. For other prisms, the volume is found by first calculating the area of the base, then using the formula $V = A \times h$.
4. The capacity of a container can be calculated using:
   $1\ \text{cm}^3 = 1\ \text{mL}$ and $1\ \text{m}^3 = 1000\ \text{L}$

EXERCISE
3E Volume of a prism

eBook plus

Digital doc
SkillSHEET 3.5
doc-1479
Converting units of volume

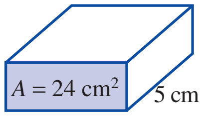
eBook plus

Digital doc
SkillSHEET 3.6
doc-1480
Volume of cubes and rectangular prisms

eBook plus

Digital doc
EXCEL Spreadsheet
doc-1481
Volume

1 WE13 Calculate the volume of each of the solids below.

a


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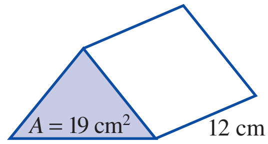

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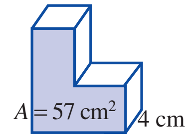
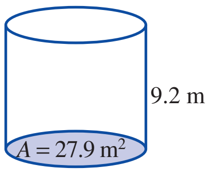
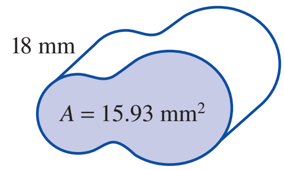
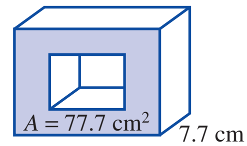


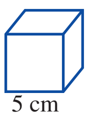
d


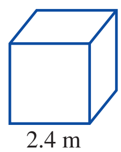
e


f


2 A prism has a base area of 74.5 m^2 and a height of 3.1 m. Calculate the volume.

3 WE14 Calculate the volume of each of the cubes below.

a


b


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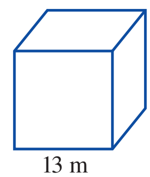

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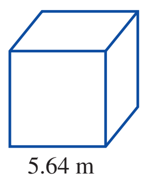

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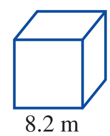
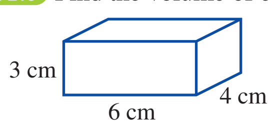


4 WE15 Find the volume of each of the rectangular prisms below.

a


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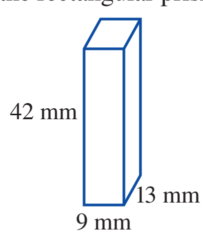

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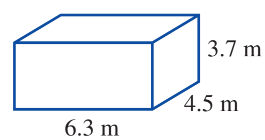

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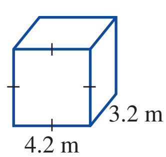

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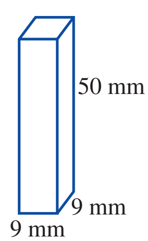

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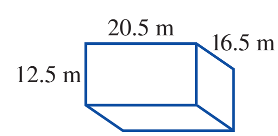
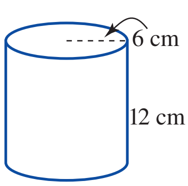


5 WE16 Calculate the volume of each of the cylinders below, correct to 1 decimal place.

a


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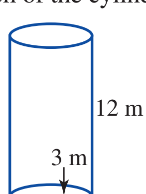

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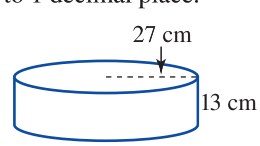

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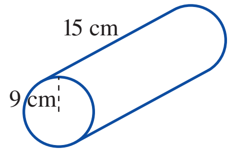

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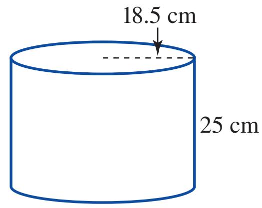

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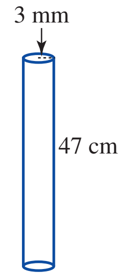
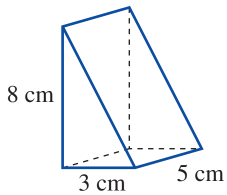


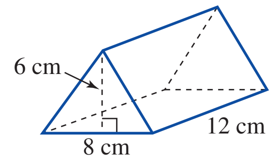
6 WE17 For each of the following triangular prisms find:

i the area of the front face **ii** the volume of the prism.

a



b



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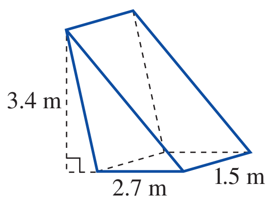

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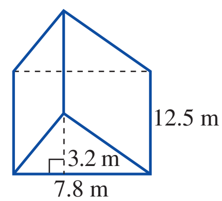
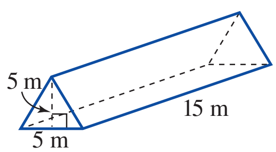


7 Find the volume of each of the following prisms by first calculating the area of the front face.

a



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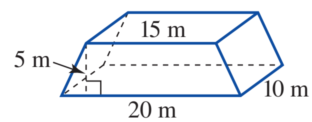

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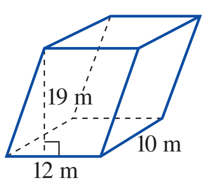

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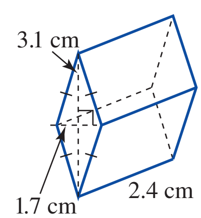
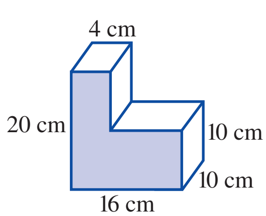


8 In each of the following, the prism's front face is made up of a composite figure. For each:

i calculate the area of the front face **ii** find the volume of the prism.

a



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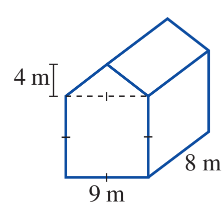

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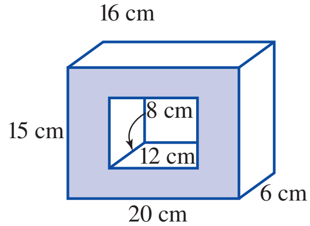

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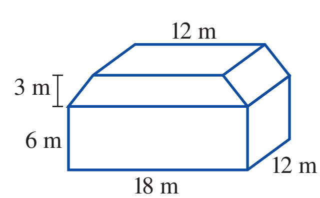
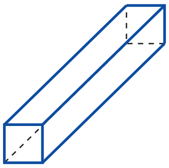


9 MC The shape at right could be described as a:

A cube
B square prism
C rectangular prism
D both B and C



10 MC The area of the front face of a prism is 34.67 cm^2, and the height is 3.6 cm. The volume of the prism is:

A 38.27 cm^2
B 38.27 cm^3
C 124.12 cm^2
D 124.812 cm^3

11 MC The dimensions of a rectangular prism are all doubled. The volume of the prism will increase by a factor of:

A 2
B 4
C 6
D 8

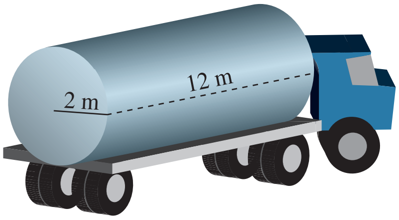
12 A refrigerator is in the shape of a rectangular prism. The internal dimensions of the prism are 60 cm by 60 cm by 140 cm.

a Find the volume of the refrigerator in cm^3.

b The capacity of a refrigerator is measured in litres. If 1 cm^3 = 1 mL, find the capacity of the refrigerator in litres.

13 A semi-trailer is 15 m long, 2.5 m wide and 2.7 m high. Find the capacity of the semi-trailer in m^3.

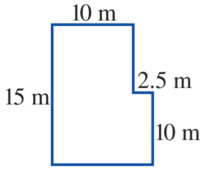
14 A petrol tanker is shown at right. The tank is cylindrical in shape. The radius of the tank is 2 m and the length is 12 m. Calculate:



a the volume of the tank, correct to 3 decimal places

b the capacity of the tank, to the nearest 100 litres. (1 m^3 = 1000 L).

15 At right is a diagram of a concrete slab for a house.



a Calculate the area of the slab.

b The slab is to be 10 cm thick. Calculate the volume of concrete needed for the slab. (*Hint:* Write 10 cm as 0.1 m.)

c Concrete costs \$45.50/m^3 to lay. Calculate the cost of this slab.

16 A rectangular roof is 14 m long and 8 m wide. When it rains, the water is collected in a cylindrical tank.

a Calculate the volume of water collected on the roof when 25 mm of rain falls.

b How many litres of water does the roof collect?

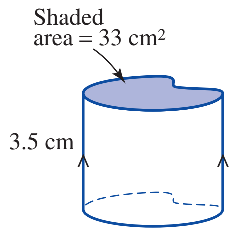
c The cylindrical tank has a radius of 1.8 m and is 2.4 m high. What is the capacity of the tank, in litres?

d By how much does the depth of water in the tank rise when the rain falls? Answer in centimetres, correct to 1 decimal place.

Further development

17 Find the volume of each of the following shapes.

a



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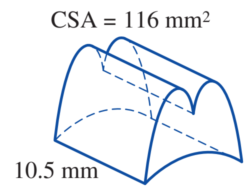
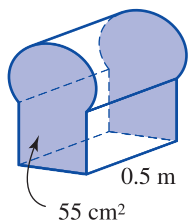


c



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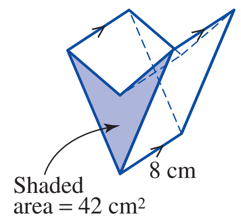
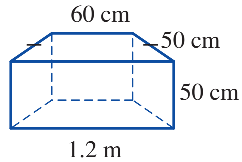
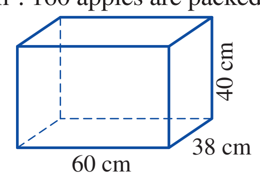


18 The figure below shows a concrete paver in the shape of a trapezoidal prism.



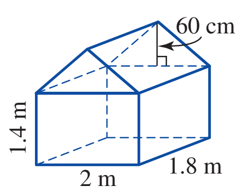
Calculate the number of pavers that will have a total volume of $10\,\text{m}^3$.

19 An apple has a volume of $512\,\text{cm}^3$. 160 apples are packed into the box drawn below.



Calculate the amount of wasted space in the box.

20 Find the volume of the following figure.



21 A cube has a volume of $778.688\,\text{cm}^3$. Find the side length.

22 A rectangular prism has a square base, and the height is twice the length of the other two sides. Find the dimensions of the prism given that it has a volume of $600\,\text{cm}^3$.

3F Volume of other solids

Prisms are only one type of solid shape. In this section we find the volume of pyramids, cones and spheres.

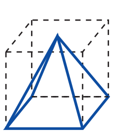
Pyramids

The volume of any pyramid is one-third of the volume of the corresponding prism.

This leads us to the general formula for the volume of any pyramid:

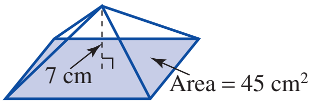
$$V = \frac{1}{3}Ah$$

where A is the area of the base and h is the height of the pyramid.



WORKED EXAMPLE 18

Find the volume of the pyramid at right.



THINK	WRITE
1 We are given A and h, so use the general formula.	$V = \frac{1}{3}Ah$
2 Substitute the value of A and h.	$= \frac{1}{3} \times 45 \times 7$
3 Calculate V.	$= 105\text{ cm}^3$

In other cases we may need to calculate the area of the base before we are able to use the general formula for the volume of a pyramid.

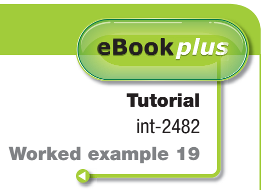
Cones

A cone is a circular pyramid. By substituting the formula for the area of a circle into the general formula for the volume of a pyramid, we find the formula for the volume of any cone.

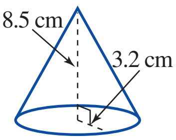
$A = \pi r^2$ when substituted into $V = \frac{1}{3}Ah$ becomes

$$V = \frac{1}{3}\pi r^2 h$$

WORKED EXAMPLE 19



Find the volume of the cone at right, correct to 2 decimal places.



THINK	WRITE
1 Write the formula.	$V = \frac{1}{3}\pi r^2 h$
2 Substitute the radius and height.	$= \frac{1}{3} \times \pi \times 3.2^2 \times 8.5$
3 Calculate the volume.	$= 91.15\text{ cm}^3$

Spheres

A sphere is a solid that looks like a ball. To find the volume of a sphere we need only the radius. The volume is calculated using the formula:

$$V = \frac{4}{3}\pi r^3$$

WORKED EXAMPLE 20

Find the volume of a sphere with a radius of 9.5 cm, correct to the nearest cm^3.

THINK	WRITE
1 Write the formula.	$V = \frac{4}{3}\pi r^3$
2 Substitute the radius.	$= \frac{4}{3} \times \pi \times 9.5^3$
3 Calculate the volume.	$= 3591\text{ cm}^3$

REMEMBER

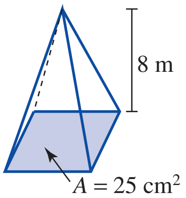
1. The volume of a pyramid is found using the formula $V = \frac{1}{3}Ah$, where A is the area of the base and h is the height.
2. The volume of a cone is found using the formula $V = \frac{1}{3}\pi r^2 h$.
3. The volume of a sphere is found using the formula $V = \frac{4}{3}\pi r^3$.

EXERCISE

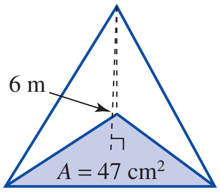
3F Volume of other solids

1 WE18 Find the volume of each of the pyramids below.

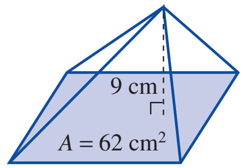
a



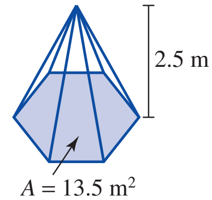
b



c

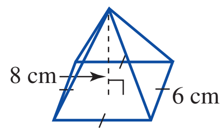


d



2 For each of the following pyramids, calculate the volume by first calculating the area of the base shape.

a



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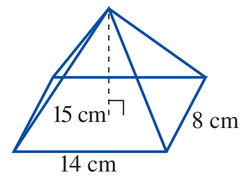
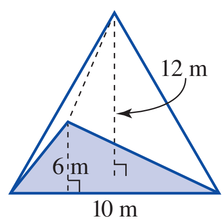


c



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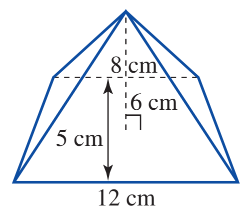

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EXCEL Spreadsheet
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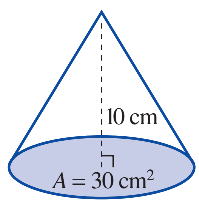
Volume of a cone

3 Use the formula $V = \frac{1}{3}Ah$ to find the volume of the following cones.

a



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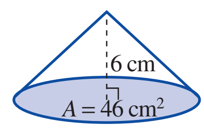

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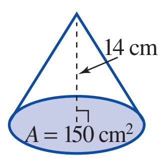

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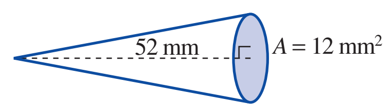
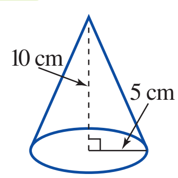


4 **WE19** Find the volume of each of the following cones, correct to the nearest whole number.

a



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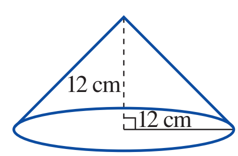
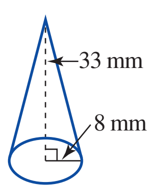


c



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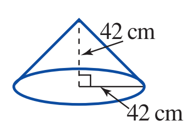
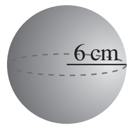
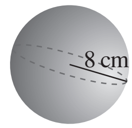


5 A cone has a base with a diameter of 9 cm and a height of 12 cm. Calculate the volume of that cone, correct to 1 decimal place.

6 WE20 Calculate the volume of each of the following spheres, correct to 1 decimal place.

a


b


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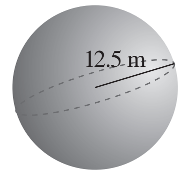

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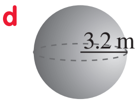
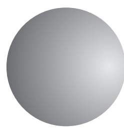


7 Calculate the volume of a sphere with a diameter of 2.3 cm. Answer correct to 2 decimal places.

8 MC Which of the following solids could not be described as a pyramid?

A


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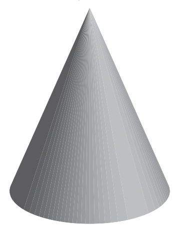
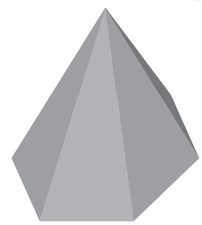


C


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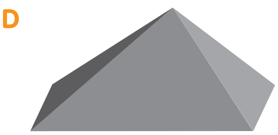


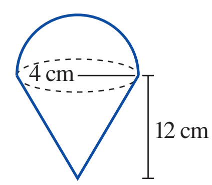
9 MC A triangular pyramid and a square pyramid both have a base area of 20 cm^2 and a height of 15 cm. Which has the greater volume?

A The triangular pyramid
B The square pyramid
C Both have equal volume
D This can't be calculated.

10 MC A spherical balloon has a volume of 500 cm^3. It is then inflated so that the diameter of the balloon is doubled. The volume of the balloon will now be:

A 1000 cm^3
B 2000 cm^3
C 3000 cm^3
D 4000 cm^3

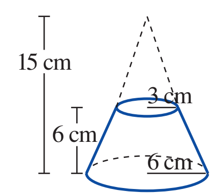
11 Find the volume of the solid at right. Answer correct to 1 decimal place.



12 A hollow rubber ball is to be made with a radius of 8 cm, and the rubber to be used is 1 cm thick.

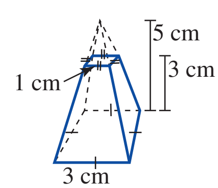
a What would be the radius of the hollow inside?
b Calculate the volume of the ball.
c Calculate the volume of space inside the ball.
d Calculate the amount of rubber (in cm^3) needed to make the ball.

13 The figure at right is a truncated cone, that is, a cone with the top cut off.



a Calculate the volume of the cone before it was truncated.
b The portion cut off was itself a cone. Calculate its volume.
c Calculate the volume of the truncated cone.

14 Use the same method as in question **13** to find the volume of the truncated pyramid shown at right.



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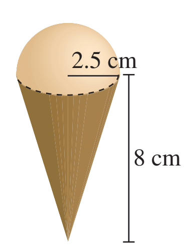
15 The figure at right is of an ice-cream cone, containing a spherical scoop of ice-cream.

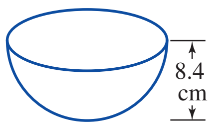


a Calculate the volume of the cone.
b Calculate the volume of the scoop of ice-cream.
c Calculate the total volume of the shape. (*Hint:* Only half the sphere sits above the cone.)

Further development

16 Find the volume of each of the following correct to one decimal place.

a



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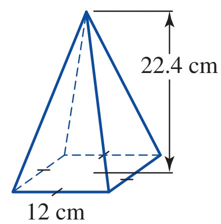
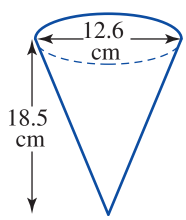


c



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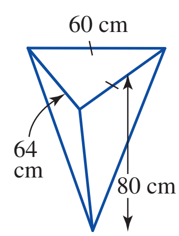


17 The diagram below shows a tennis canister that contains four tennis balls each of diameter 7 cm.

a What is the radius and height of the canister?

b Find the volume of the canister correct to the nearest cm^3.

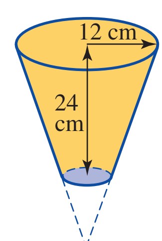
c Find the amount of empty space in the canister.

18 A cosmetic eye mask is 12 mm thick and filled will a special liquid. Find the volume of the liquid given that the mask has a cross sectional area of $140\,cm^2$.

19 Fifty small chocolates are to be placed inside a spherical ball. Given that each chocolate has a volume of $0.8\,cm^3$, find the diameter of the spherical ball.

20 One hundred spherical marbles of diameter 1 cm are put into a larger sphere of diameter 10 cm. Find the percentage of space inside the larger sphere that is occupied.

21 The vase drawn at right is a frustum, which is a cone with part cut off. The height of the frustum is 24 cm, which is two-thirds the height of the full cone. Find the volume of the frustum.



SUMMARY

Area

- Area formulas that you will need to remember are:

Square	$A = s^2$
Rectangle	$A = l \times b$
Triangle	$A = \frac{1}{2} \times b \times h$
Parallelogram	$A = b \times h$
Rhombus	$A = \frac{1}{2} \times D \times d$
Trapezium	$A = \frac{1}{2} \times (a + b) \times h$

- Irregular areas have their area calculated using a survey. A traverse survey is done, a field diagram is drawn that will allow the shape to be divided into triangles and quadrilaterals, then the area is calculated.

Solid shapes

- Prisms are solids with a constant cross-section.
- Pyramids have a plane shape as a base and triangular sides that meet in an apex.
- The net of a solid is what the shape would look like if it were unfolded and laid flat.
- Solid shapes can be drawn on isometric paper to locate the vanishing point.

Surface area

- The surface area is the total area of all faces on a solid shape.
- Surface area formulas:

Cube	$SA = 6s^2$
Rectangular prism	$SA = 2(lh + lb + bh)$

- Many solid shapes have their surface area calculated by separately calculating the area of each face.

Volume

- The volume is the amount of space inside a solid shape.
- Volume formulas that you will need:

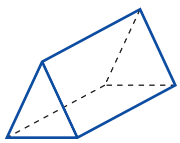
Cube	$V = s^3$
Rectangular prism	$V = l \times b \times h$
Cylinder	$V = \pi r^2 h$
Cone	$V = \frac{1}{3}\pi r^2 h$
Sphere	$V = \frac{4}{3}\pi r^3$

- Any other prism has its volume calculated by using the formula $V = A \times h$, where A is the area of the base and h is the height.
- Any other pyramid has its volume calculated using the formula $V = \frac{1}{3} \times A \times h$.

CHAPTER REVIEW

MULTIPLE CHOICE

1 **MC** Which of the solids below is not a prism?

A


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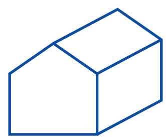
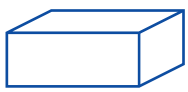


C


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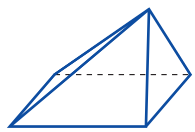


2 **MC** A cube has a side length of 4 cm.
I: The surface area of the cube is 64 cm^2.
II: The volume of the cube is 96 cm^3.
Which of the above statements is correct?

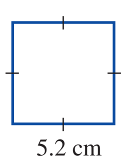
A I only
B II only
C Both I and II
D Neither I nor II

3 **MC** A prism and a pyramid both have a rectangular base of area 50 cm^2 and have equal volumes. The height of the prism is 5 cm. The height of the pyramid is:

A 5 cm
B 10 cm
C 15 cm
D 20 cm

SHORT ANSWER

1 Find the area of each of the figures drawn below.

a


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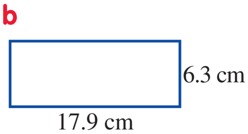

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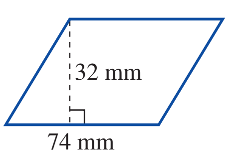

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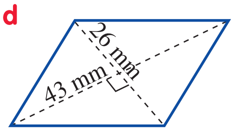

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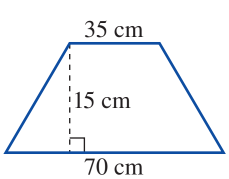

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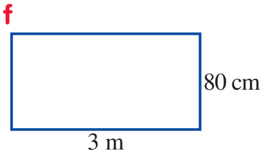
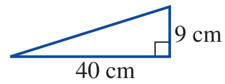


2 Find the area of each of the triangles drawn below.

a


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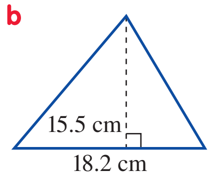

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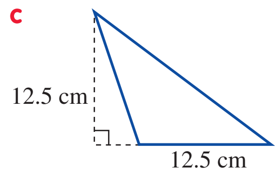

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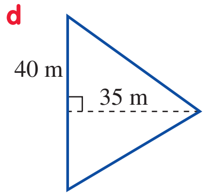
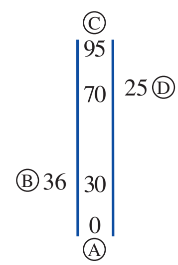


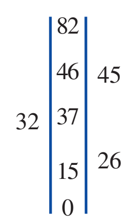
3 At right is the field diagram for a block of land.

a Use the scale 1 mm = 1 m to draw a scale diagram of the block of land.

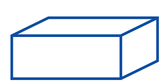
b Calculate the area of the block of land.



4 Calculate the area of the block of land represented by the field diagram at right.



5 Name each of the solids below.

a


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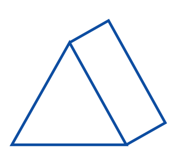

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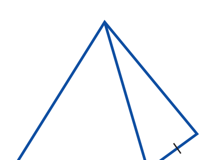
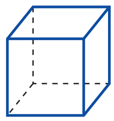
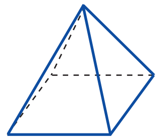
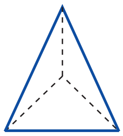


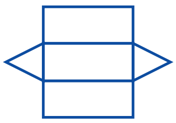
6 Draw the net of each of the following solids.

a 

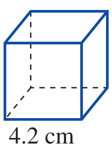
b 

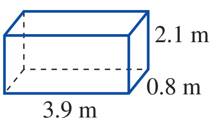
c 

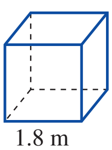
7 Name the solid shape for which the net is given at right.

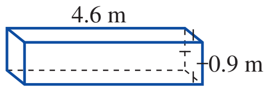


8 Find the surface area of each of the following solids.

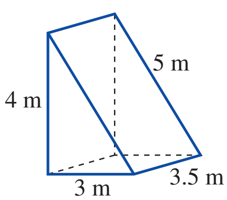
a 

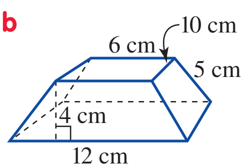
b 

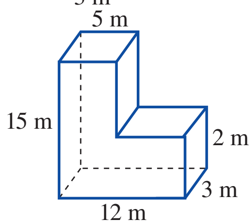
c 

d 

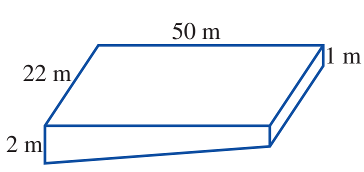
9 Calculate the surface area of each of the figures below, by calculating the area of each face separately and adding them.

a 

b 

c 

10 Below is a diagram of an Olympic swimming pool.



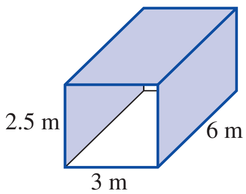
a Calculate the area of one side wall.

b Use the formula $V = A \times h$, to calculate the volume of the pool.

c How many litres of water will it take to fill the pool? ($1 \text{ m}^3 = 1000 \text{ L}$)

d The walls and floor of the pool need to be painted. Calculate the area to be painted.

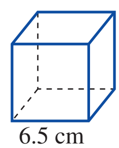
11 At right are the plans for a garage that Rob is building. (*Note:* The garage has an iron roof and is closed at one end.)

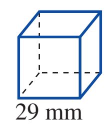


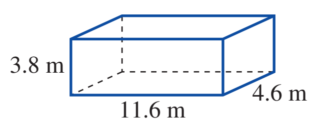
a Calculate the area that will need to be bricked.

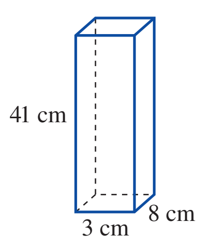
b If each brick is 20 cm long and 8 cm high, how many will be needed to complete the job?

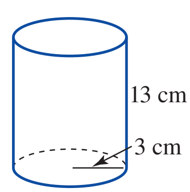
12 Use the formulas to calculate the volume of each of the following cubes, rectangular prisms and cylinders.

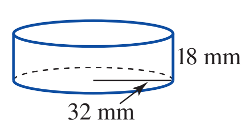
a 

b 

c 

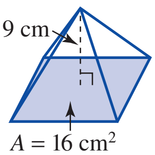
d 

e 

f 

13 A prism has a base area of 45 cm^2 and a height of 13 cm. Calculate the volume.

14 Use the formula $V = \frac{1}{3}Ah$ to calculate the volume of each of the pyramids below.

a


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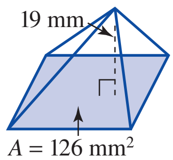
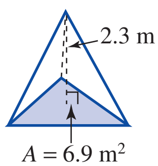
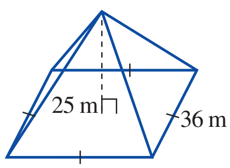
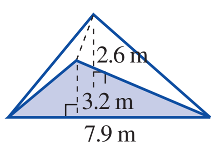


c


15 Calculate the volume of each of the pyramids, cones and spheres below.

a


b


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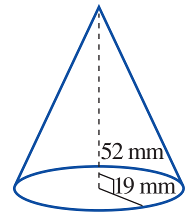

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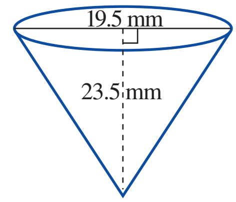

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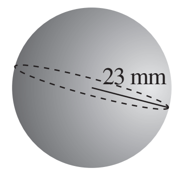

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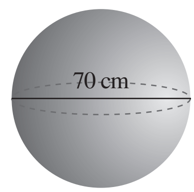
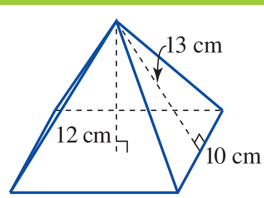


EXTENDED RESPONSE

1 The figure at right is a square pyramid.
- **a** Calculate the area of the base.
- **b** Calculate the volume of the pyramid.
- **c** Calculate the surface area of the pyramid.
- **d** Draw the net of the pyramid.



2 A ice-cream cone has a base radius of 2.5 cm and a height of 12 cm.
- **a** Calculate the volume of the cone, correct to 1 decimal place.
- **b** Calculate the capacity of the cone in millilitres.
- **c** A scoop of ice-cream in the shape of a sphere is to sit inside the cone. Calculate the volume of the scoop.
- **d** How many scoops can be obtained from a 4 litre tub of ice-cream?

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Digital doc
Test Yourself
doc-1484
Chapter 3

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ACTIVITIES

Are you ready?

Digital docs *(page 78)*
- SkillSHEET 3.1 (doc-1470): Areas of squares, rectangles, triangles and circles
- SkillSHEET 3.2 (doc-1471): Converting units of area
- SkillSHEET 3.3 (doc-1477): Surface area of cubes and rectangular prisms
- SkillSHEET 3.5 (doc-1479): Converting units of volume
- SkillSHEET 3.6 (doc-1480): Volume of cubes and rectangular prisms

3A Review of area

Digital docs
- SkillSHEET 3.1 (doc-1470): Areas of squares, rectangles, triangles and circles *(page 81)*
- SkillSHEET 3.2 (doc-1471): Converting units of area *(page 81)*
- Spreadsheet (doc-1472): Area converter (DIY) *(page 81)*
- GC program — Casio (doc-1473): Mensuration *(page 82)*
- GC program — TI (doc-1474): Mensuration *(page 82)*
- Spreadsheet (doc-1475): Perimeter and area *(page 82)*

3B Calculating irregular areas from a field diagram

Interactivity
- int-2407: Field diagram. *(page 86)*

Tutorial
- WE6 int-2304: Explore an application of field diagrams. *(page 87)*

3C Solid shapes

Digital docs
- WorkSHEET 3.1 (doc-1476): Evaluate problems involving area *(page 92)*

3D Surface area

Digital docs
- SkillSHEET 3.3 (doc-1477): Surface area of cubes and rectangular prisms *(page 95)*
- SkillSHEET 3.4 (doc-1478): Surface area of triangular prisms *(page 95)*

3E Volume of a prism

Tutorial
- WE16 int-2481: Evaluate the capacity of a cylinder. *(page 100)*

Digital docs
- SkillSHEET 3.5 (doc-1479): Converting units of volume *(page 101)*
- SkillSHEET 3.6 (doc-1480): Volume of cubes and rectangular prisms *(page 101)*
- Spreadsheet (doc-1481): Volume *(page 101)*

3F Volume of other solids

Tutorial
- WE19 int-2482: Evaluate the volume of a cone. *(page 105)*

Digital docs
- Spreadsheet (doc-1482): Volume of a cone *(page 107)*
- WorkSHEET 3.2 (doc-1483): Evaluate problems involving surface area and volume. *(page 108)*

Chapter review

- Test yourself Chapter 3 (doc-1484): Take the end-of-chapter test to test your progress. *(page 113)*

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